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THESIS

IMPACT OF DEFENSE INDUSTRY MERGERS ON THE COST OF MILITARY WEAPONS SYSTEMS

by

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December 2007

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13. ABSTRACT (maximum 200 words)

The United States defense industry has been in a constant state of consolidation over the last 16 years. This thesis reports the impact of these defense related mergers on the cost of military weapons systems. The Selected Acquisition Reports (SARs) provided the data for this research. The analysis of the data suggests that the defense industry's consolidation did not result in higher costs for DoD's military weapons in the post-merger period. This report concludes that on average approximately 76.4 percent of the weapons systems produced by Lockheed Martin, Boeing, or Northrop Grumman, the three largest defense contractors respectively based on 2006-awarded contracts, experienced a statistically significant change in their cost estimates. Weapon systems in the fixed wing aircraft category were most impacted by defense related mergers. About 72.7 percent of the systems in this category showed a statistically significant change in cost estimates, of which 63.6 percent exhibited a statistically significant decrease in cost estimates. Weapon systems in the strategic electronics category were also highly impacted by defense related mergers. About 75 percent of the systems in this category showed a significant change in cost estimates, of which 50 percent exhibited a statistically significant decrease.

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IMPACT OF DEFENSE INDUSTRY MERGERS ON THE COST OF MILITARY WEAPONS SYSTEMS

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

The United States defense industry has been in a constant state of consolidation over the past sixteen years. This thesis reports the impact of these defense related mergers on the cost of military weapons systems. The Selected Acquisition Reports (SARs) provided the data for this research. The analysis of the data suggests that the defense industry's consolidation did not result in higher costs for the DoD's military weapons in the post-merger period. This report concludes that, on average, approximately 76.4 percent of the weapons systems produced by Lockheed Martin, Boeing, or Northrop Grumman, the three largest defense contractors respectively, based on 2006-awarded contracts, experienced a statistically significant change in their cost estimates.

Of the weapon systems manufactured by the "Top Three," on average, 66.7 percent exhibited a statistically significant decrease in cost estimates. Weapon systems in the fixed-wing aircraft category were most impacted by defense-related mergers. About 72.7 percent of the systems in this category showed a statistically significant change in cost estimates, of which 63.6 percent exhibited a statistically significant decrease in cost estimates. Weapon systems in the strategic electronics category were also highly impacted by defense-related mergers. About 75 percent of the systems in this category showed a significant change in cost estimates, of which 50 percent exhibited a statistically significant decrease. The Selected Acquisition Reports (SARs) summary tables provided the cost data for this report. Over 280 military weapon systems, with more than 6,800 lines of data, were analyzed.

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LIST OF ACRONYMS

DoD	Department of Defense
DTIC	Defense Technical Information Center
GAO	Government Accountability Office
MDAP	Major Defense Acquisition Program
OSD	Office of the Secretary of Defense
SAR	Selected Acquisition Report

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I. INTRODUCTION

A. BACKGROUND

The United States defense industry has been in a constant state of consolidation over the past sixteen years. As the number of major defense contractors continues to diminish, many are concerned about the impact of these mergers on the costs of weapons systems. The purpose of this report is to examine the impact of mergers among major defense contractors on the costs of military weapons systems.

The Selected Acquisition Reports (SARs) summary tables[1] provided the cost data for this report. SARs summarize the latest estimates of cost, schedule, and technical status. The period covered in the SAR data used in this analysis were between March 1981 and June 2006. This research included over 260 military weapon systems and more than 6,800 lines of data. A great percentage of the weapons systems were eliminated from the analysis for numerous reasons — explained in more detail in the methodology section below — in order to ensure that the results were robust.

[1] Office of the Undersecretary of Defense for Acquisition Technology, and Logistics http://www.acq.osd.mil/ara/am/sar/index.html.

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II. CONDITIONS UNDERLYING CONSOLIDATION WITHIN THE DEFENSE INDUSTRY

The end of the Cold War ushered in an era of declining defense budgets and sharply reduced expenditures for military procurement, which forced deep cuts in the number and size of weapons programs. In fact, the overall U.S. defense budget has decreased from a peak of $390 billion in 1985 (in constant fiscal year 1997 dollars) to $252 billion in 1997 — a reduction of about 35 percent[2]. More important, from the defense contractors' perspective, however, the procurement budget has incurred the brunt of these cuts, shrinking from about $125 billion (fiscal year 1997 dollars) in 1985 to about $44 billion in 1997, a 65 percent reduction[3]. A decline in demand of this magnitude, which occurred in an industry that had invested heavily in plants and infrastructure in the early 1980s based on expectations of continued growth in the demand for weapons and military systems, led quickly to overcapacity among defense contractors[4]. This overcapacity, in turn, contributed to excess overhead and higher costs for U.S. military programs. The defense industry responded by reducing capacity through consolidation, which has resulted in a significant decline in the number of defense contractors. Defense Department officials have encouraged consolidation within the industry as an inevitable consequence of shrinking procurement budgets. It has been widely reported, for instance, that in 1993

[2] Statement of Robert Pitofsky, Chairman of The Federal Trade Commission, Before The Committee on the Judiciary Subcommittee on Antitrust, Business Rights, and Competition United States Senate (July 24, 1997).

[3] Statement of John B. Goodman, Deputy Under Secretary of Defense (Industrial Affairs and Installations), Before the Subcommittee on Acquisition and Technology of the Senate Committee on Armed Services, (April 15, 1997).

[4] Statement of Robert Pitofsky, Chairman of The Federal Trade Commission, Before The Committee on the Judiciary Subcommittee on Antitrust, Business Rights, and Competition United States Senate (July 24, 1997).

then-Deputy Defense Secretary William Perry urged defense industry executives to combine into a few, large companies to eliminate costly overcapacity[5].

This defense industry consolidation began in the early 1990s with many mergers valued at some $300 million. However, the pace accelerated considerably by 1993, when the value of defense-related mergers climbed to $14.2 billion, topped more than $20 billion in 1996 and, just a decade later, the value of defense mergers doubled to reach an astonishing $40 billion[6]. Some of the mergers with the highest value took place in 1993 when Martin Marietta purchased General Electric's defense division and General Dynamics' space division. At about the same time, Lockheed purchased General Dynamics' aircraft division, while Loral purchased LTV, Ford Aerospace, and Unisys. Then, in 1994, Lockheed merged with Martin to become Lockheed Martin, and a year later, Lockheed Martin purchased Loral to produce a $30 billion giant known as Lockheed Martin Loral.

The combined company, as of 2006, was awarded approximately 40 percent of the Pentagon's procurement budget[7]. In 2007, the upwards trend in the DoD's procurement budget continued, reaching over $83 billion[8].

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[5] Statement of John B. Goodman, Deputy Under Secretary of Defense (Industrial Affairs and Installations), Before the Subcommittee on Acquisition and Technology of the Senate Committee on Armed Services, (April 15, 1997).

[6] Ibid.

[7] Office of the Under Secretary of Defense for Acquisition & Technology, Report of the Defense Science Board Task Force on Antitrust Aspects of Defense Industry Consolidation.

[8] Government Printing Office, http://www.gpoaccess.gov/usbudget/fy07/pdf/budget/defense.pdf.

III. METHODOLOGY

An exhaustive review of literature related to defense merger activity was conducted using the Lexus/Nexus database, Internet, journals, periodicals, Jane's Defense, GAO reports, SARs, and testimonies to Congress on the impact of defense mergers. Data collection focused on cost data from SARs' summary tables. The cost data was transferred to an Excel spreadsheet as it appeared on the SAR summary tables and re-checked to ensure the accuracy of the data. The report periods reviewed included data weapons system historical cost data from March 1981 to June 2006.

An in-depth review of over 260 weapons systems and more than 6,800 lines of data yielded 46 weapons systems that met the criteria necessary for this analysis. Many systems were eliminated because there were not enough data points before or after the merger to assess the impact of the merger, or because there either was not a merger during the time period covered by the data, or it was unclear whether that merger affected that particular weapons system. For example, if Raytheon acquired a smaller system during the time period for which there was data on a weapons system, that merger would not have been included in this analysis if it was unclear that this particular merger affected this particular weapons system. This thesis examines current year cost estimates in base year dollars for each weapons system over time because it encompasses many of the ways in which a merger could impact costs and because it controls for inflation since it is normalized to a base year[9].

The regression model used current year cost estimates in base year dollars as the dependent variable. The independent variables were a time trend, to control for changes over the passage of time, and a merger dummy variable that took on the value of "1" following a merger of the contractor who made the weapons system and a "0" before the merger. The regression model was then

[9] This follows a similar methodology to NPS- GSBPP-06-000, a technical report written by Dr. Nayantara Hensel entitled "An Empirical Analysis of the Patterns in Defense Industry Consolidation and their Subsequent Impact" (2007).

run for each military weapons system. In one case, we assumed that the merger effect kicked at the SAR date nearest to the merger. In the second case, we assumed that the effect kicked in at the second nearest SAR to the merger. The results in Tables 3-6 use the regressions, which assume that the effect kicked in at the second nearest SAR[10].

In using the quantitative approach to process the cost data, relevant historical data was obtained. The historical data is numerical, readily available and consistent over a long period, and provides insight into the interaction between supplier and consumer. The cost data located on the Selected Acquisition Reports (SAR) fits the necessary description for historical cost data mentioned above. Given the characteristics of the data, regression analysis was the tool of choice to process the cost data. Regression analysis examines the relation of a dependent variable, the "output" or "response variable" to a specified independent variable, "inputs or "explanatory variables." The estimates measure the relationship between the dependent variable and each of the independent variables. In mathematics, an independent variable is any of the argument, which is a statement (premise) or group of statements (premises) offered in support of another statement (conclusion).

Some of the weapon systems in the raw data set were eliminated for the following reasons: some weapons systems did not have sufficient observations (less than 10) for the analysis to be robust/statically significant; this represented approximately 60.5 percent of all the weapons systems analyzed. There were instances when no merger activity occurred by the original manufacturer of the weapon systems in the database between the dates given; this represented approximately 36.6 percent of all the weapons systems analyzed. Finally, any weapon system or program cancelled by DoD regardless of merger activity or defense contractor was not considered; this represented only approximately 2.5 percent of all the weapons systems analyzed.

[10] This follows a similar methodology to NPS- GSBPP-06-000, a technical report written by Dr. Nayantara Hensel entitled "An Empirical Analysis of the Patterns in Defense Industry Consolidation and their Subsequent Impact" (2007).

IV. SELECTED ACQUISITION REPORT COST DATA

SARs are prepared annually as required by Title 10 USC § 2430 of the United States Code and developed in conjunction with the President's budget. SARs summarize the latest estimates of cost, schedule, and technical status and each contains a great deal of information regarding a particular weapon system. Information such as the mission of the weapons system, major and secondary contractors involved in manufacturing the system, and data on the costs of the weapons system, such as baseline cost estimates and current cost estimates[11].

The total program cost estimates provided in the SARs include research and development, procurement, military construction, and acquisition-related operation and maintenance (except for pre-Milestone B programs which are limited to development costs pursuant to 10 USC §2432). Subsequent quarterly reports are required only for those programs experiencing unit cost increases of at least 15 percent or schedule delays of at least six months. Quarterly SARs are submitted for initial reports, final reports, and for programs that are rebaselined at major milestone decisions. Total program costs reflect actual costs to date as well as future anticipated costs. All estimates include anticipated inflation allowances.

> On an annual basis, the DoD reports the acquisition costs of Major Defense Acquisition Programs (MDAPs) to Congress. Title 10 USC § 2430 defines a Major Defense Acquisition Program as a Department of Defense (DoD) acquisition program that is not a highly sensitive classified program (as determined by the Secretary of Defense). Additionally, the Secretary of Defense must designate the program as major defense acquisition program. Finally, the program must be estimated by the Secretary of Defense, to require an eventual total expenditure for research, development, test, and evaluation of more than $365,000,000 (updated to FY 2000

[11]Hensel, Dr. Nayantara. NPS- GSBPP-06-000, “An Empirical Analysis of the Patterns in Defense Industry Consolidation and their Subsequent Impact,” (2007).

constant dollars) or an eventual total expenditure for procurement of more than $2,190,000,000 (updated to FY 2000 constant dollars)[12].

Selected Acquisition Reports (SARs) are external reports containing MDAP information submitted to Congress. The SAR contains information such as: an executive summary, the mission of the weapon system, the costs of the weapon systems, the contractors involved and much more. Even though SARs in their entirety are difficult for the public to obtain, the SAR summary tables, are readily available for all interested individuals. A quantitative analysis of the impact of defense mergers can be conducted with the cost data contained in these reports. The cost data is broken out by weapon system, and provides the original cost estimate given to the U.S. government, what it is currently expected to cost the US government, and the specific reasons for the cost changes in relation to the baseline of the program.

The definitions of the cost data reported in the SAR summary tables may be found in DoD 7000.3-G, Preparation and Review of Selected Acquisition Reports[13.]

[12] United States Government Printing Office (GPO), United States Code Electronic Edition, http://www.access.gpo.gov/uscode/title10/subtitlea_partiv_chapter144_.html.

[13] Defense Technical Information Center, http://www.dtic.mil/whs/directives/corres/html/700003g.htm

V. TABLES

The tables below represent the results of analyzing SARs' cost data of military weapon systems. Tables 1 and 2 directly below show the results of the regressions (statistical analysis) of the cost data gathered from the SARs by weapons system. The second and fourth columns have the coefficients of the post-merger dummy variable and the time trend, respectively. The third and fifth columns provide the p-value for the statistical significance of these coefficients[14].

Table 1. Post-Merger Statistical Results Beginning With SAR Closest to the Merger Effective Date

Weapons System	Coefficient on post-merger indicator variable	P value on coefficient for post-merger indicator variable	Coefficient on time trend variable	P value on coefficient for time trend variable
AH-64	36.961	0.763	47.257	0.000
AIM-9X	1554.800	0.000	4.878	0.568
ASAS	-1419.660	0.000	16.395	0.046
AMRAAM	-2826.000	0.000	183.260	0.000
ATACMS	134.470	0.366	29.903	0.000
ATACMS-APAM	-62.350	0.889	-12.050	0.575
ATACMS-BAT	1456.657	0.000	32.566	0.073
AV-8B	-113.640	0.001	6.545	0.005
ATICRM	-49.355	0.899	64.324	0.007
C-17	17687.660	0.000	319.770	0.000
C-130J	578.055	0.453	509.426	0.006
DDG-51	-6357.780	0.001	740.820	0.000
F-16	-3235.558	0.031	58.599	0.088
FA-18	-21133.990	0.002	635.600	0.014

[14] Hensel, Dr. Nayantara. NPS- GSBPP-06-000, "An Empirical Analysis of the Patterns in Defense Industry Consolidation and their Subsequent Impact," (2007).

F-22	-8867.300	0.151	1074.100	0.000
Javelin	-78.669	0.840	14.043	0.291
JDAM	-669.470	0.032	147.651	0.000
JSOW	542.250	0.609	-9.995	0.827
JSTARS	-1396.200	0.003	168.990	0.000
LHD-1	251.020	0.210	53.764	0.000
Longbow Apache	-381.750	0.612	149.510	0.000
Longbow Hellfire	-759.730	0.033	36.382	0.008
NAVSTAR	-212.399	0.013	29.502	0.000
Titan IV	-9604.985	0.000	504.366	0.000
DMSP	15.714	0.322	6.557	0.000
FBCB2	-422.658	0.180	4.646	0.876
MLRS	-28.854	0.744	28.307	0.000
Strategic Sealift	58.530	0.685	20.624	0.029
T45TS	143.590	0.401	47.809	0.000
Trident	-2111.671	0.056	10.351	0.679
JPATS	744.526	0.047	124.020	0.000
JASSM	365.077	0.396	121.099	0.000
AFATDS	201.654	0.326	-4.534	0.756
ABL	-1710.842	0.353	269.662	0.177
E-2C	-4905.183	0.000	72.741	0.000
EFV	-3392.319	0.001	405.151	0.000
ATIRCM	733.037	0.126	7.203	0.790
Global Hawk	65.339	0.112	50.555	0.094
JDAM	-385.267	0.331	133.076	0.000
LANTIRN	-37.563	0.612	3.294	0.066
MCS	179.676	0.046	-12.833	0.003
GBS	391.484	0.685	73.087	0.144
FMTV	-987.369	0.387	124.471	0.000
ATARS	542.689	0.012	-37.774	0.035
T-AKE	-134.735	0.457	-12.775	0.277
THAAD	-2513.177	0.358	544.368	0.000

Table 2. Post-Merger Statistical Results Beginning With SAR One Period Beyond Closest to the Merger Effective Date

Weapon System	Coefficient on post-merger indicator variable	P value on coefficient for post-merger indicator variable	Coefficient on time trend variable	P value on coefficient for time trend variable
AH-64	87.880	0.480	45.650	0.000
AIM-9X	1279.300	0.000	9.408	0.422
ASAS	-1004.900	0.002	-8.205	0.733
AMRAAM	-2953.600	0.000	184.600	0.000
ATACMS	234.600	0.108	27.200	0.000
ATACMS-APAM	-91.554	0.798	-9.907	0.674
ATACMS-BAT	1201.149	0.005	37.710	0.074
AV-8B	-116.950	0.001	7.088	0.004
ATICRM	255.640	0.504	49.295	0.031
C-17	17138.700	0.000	336.680	0.000
C130J	778.055	0.867	423.921	0.002
DDG-51	-7478.100	0.000	761.470	0.000
F16	-3032.217	0.0543	50.044	0.135
FA-18	-24329.800	0.000	751.150	0.003
F-22	-11220.000	0.067	1127.400	0.000
Javelin	1156.990	0.002	-22.196	0.067
JDAM	-698.650	0.028	149.390	0.000
JSOW	1631.280	0.126	-50.687	0.276
JSTARS	-1300.270	0.005	166.480	0.000
LHD-1	144.320	0.476	55.225	0.000
Longbow Apache	-669.240	0.372	158.100	0.000
Longbow Hellfire	-789.560	0.030	38.132	0.007
NAVSTAR	-191.890	0.024	28.756	0.000
Titan IV	-10094.500	0.000	513.140	0.000
DMSP	30.865	0.041	5.910	0.000
FBCB2	-606.340	0.056	22.475	0.456
MLRS	-34.901	0.693	28.377	0.000

Strategic Sealift	93.856	0.506	19.345	0.028
T45TS	63.699	0.707	49.373	0.000
Trident	-1489.630	0.178	-2.125	0.933
JPATS	947.420	0.006	118.270	0.000
JASSM	613.484	0.137	110.752	0.000
AFATDS	113.569	0.576	1.091	0.940
ABL	-2503.274	0.103	419.085	0.059
E-2C	-4481.181	0.000	62.946	0.000
EFV	-3170.661	0.002	401.419	0.000
ATIRCM	616.938	0.198	13.152	0.630
JDAM	-395.066	0.327	133.823	0.000
LANTIRN	-28.379	0.741	3.096	0.072
MCS	194.908	0.033	-13.599	0.002
GBS	63.547	0.557	7.755	0.0280
Global Hawk	-663.769	0.182	69.520	0.039
FMTV	-1048.561	0.436	122.812	0.000
ATARS	496.902	0.029	-35.589	0.064
T-AKE	-200.498	0.168	-6.049	0.618
THAAD	-2641.727	0.164	618.923	0.000

Table 3 summarizes the findings of Tables 1 and 2. In Table 1, the merger effect was assumed to have started with the SAR closest to the merger effective date. However, in Table 2, the merger effect was “moved” one period to start at the SAR one reporting cycle after the nearest SAR to the merger effective date. This action was taken in order to ensure that the merger effect, if any, would be completely reflected in the cost data contained in the SARs.

Of systems analyzed in Table 3, on average, regardless of whether the merger effect kicked in at the nearest SAR or the second nearest SAR to the merger, approximately 47.7 percent (note that this is the average of 41.86 percent and 53.49 percent) exhibited a statistically significant change in their cost estimates following a merger, controlling for the time trend.

Additionally, on average, approximately 30.2 percent of the systems experienced a statistically significant reduction in cost estimates in the post-merger period, controlling for the time trend, while approximately 17.4 percent of

the systems experienced a statistically significant increase in cost estimates in the post merger period, controlling for the time trend.

Table 3. Percentage of Weapons Systems Experiencing a Post-Merger Change in Cost Estimates

	Percentage of systems experiencing a positive and statistically significant change	**Percentage of systems experiencing a negative and statistically significant change**	**Percentage of systems experiencing a statistically significant change**
Post -merger effect at SAR closest to the merger effective date	13.95	27.91%	41.86%
Post-merger effect at second nearest SAR to the merger effective date	20.93%	32.56%	53.49%
Averages	17.44%	30.24%	47.68%

Table 4 summarizes the weapons systems results from Table 2 and categorizes those results based on the type of weapons system classification found in the 1998 GAO report, although this reports added the strategic electronics category. In classifying the systems into these categories, we examined materials on the website of the Federation of American Scientists, Jane's, and various materials written by defense contractors.[15].

Weapon systems in the fixed wing aircraft category were most impacted by defense- related mergers. About 72.2 percent of the systems in this category had a statistically significant change in cost estimates. Of these systems, 63.6

[15] Hensel, Dr. Nayantara. NPS- GSBPP-06-000, "An Empirical Analysis of the Patterns in Defense Industry Consolidation and their Subsequent Impact," (2007).

percent exhibited a statistically significant decrease and approximately 9.1 percent experienced a statistically significant increase in cost estimates post-merger. Weapon systems in the strategic electronics category were also highly impacted by defense related mergers. About 75 percent of the systems in this category experienced a statistically significant change in cost estimates, of which 50 percent showed a statistically significant decrease and approximately 25 percent showed a statistically significant increase in cost estimates following the merger.

Table 4. Percentage of Weapons Systems Experiencing a Post-Merger Change in Cost Estimates by Categories and Systems Type

Weapon Systems Categories and Types	**Percentage of systems in each category which experienced a statistically significant higher cost estimate post-merger**	**Percentage of systems in each category which experienced a statistically significant lower cost estimate post-merger**	**Percentage of systems in each category which experienced a statistical significant change in cost estimate post-merger**
Expandable Launch Vehicle Titan IV	0%	100%	100%
Fixed Wing Aircraft AV-8B C-17 C-130 E-2C F-16 FA-18 FA-22 Global Hawk JSTARS JPATS T-45TS	9.09%	63.63%	72.72%
Rotary Aircraft AH-64 Longbow Apache	0.00%	0.00%	0.00%
Satellite DMSP NAVSTAR	50.00%	50.00%	100.00%

Surface Ships DDG-51 LHD-1 Strategic Sealift EFV T-AKE	0.00%	40.00%	40.00%
Strategic Electronics ASAS ATCCS ATICRM ABL ATARS FBCB2 GBS MCS	25.00%	50.00%	75.00%
Strategic Missile Trident II	0.00%	0.00%	0.00%
Tactical Missile AIM-9X AMRAAM ATACMS Javelin JSOW Longbow Hellfire MLRS LANTIRN THAAD JDAM JSAM	27.27%	36.36%	63.63%
Tactical Wheeled Vehicles FMTV	0.00%	0.00%	0.00%
Tracked Combat Vehicles AFATDS MLRS	0.00%	0.00%	0.00%

Table 5 summarizes statistically significant changes in cost estimates by defense contractor. The analysis conducted found that on average approximately

47.0 percent of the weapons systems manufactured the leading defense contractors listed showed a statistically significant change in cost estimates following their mergers. Of these systems manufactured by these defense contractors found in the table below, on average, 34.6 percent experienced a statistically significant decrease in cost estimates and approximately 19.6 percent exhibited a statistically significant increase in cost estimates.

In the table below, over two-thirds of the systems made by Boeing, General Dynamics, Lockheed, and Martin Marietta, showed a substantial change in cost estimates following a merger or acquisition. As can be seen in the table, most of the contractors (with the exception of TRW, Beech Aircraft, and Martin Marietta) were more likely to have lower cost estimates than higher cost estimates. In this analysis, weapon systems manufactured by a contractor who was later acquired by another contractor on the list were included only in the calculation of the totals for the acquirer. For example, in the case of Martin Marietta and Lockheed, any weapon systems originally manufactured by Martin Marietta were accounted as part the combined company Lockheed Martin. Systems included in the table below for Martin Marietta were those in which Martin Marietta served as the acquirer of the original manufacturer of the weapon system. This action was taken to ensure accuracy and to avoid the double counting of the same weapons systems that later became part of the acquiring company.

Table 5. Summary of Statistically Significant Cost Changes by Defense Contractor

Defense Contractor	Percentage of systems made by each defense contractor which experienced a statistically significantly higher cost estimate post-merger	Percentage of systems made by each defense contractor which experienced a statistically significantly lower cost estimate post-merger	Percentage of systems made by each defense contractor which experienced a statistically significantly different estimate post-merger (higher or lower)
Boeing	12.50%	62.50%	75.00%
BAE Systems	0.00%	0.00%	0.00%
Bath Irons	0.00%	100.00%	100.00%
Beech Aircraft	100.00%	0.00%	100.00%
General Dynamics	0.00%	100.00%	100.00%
Hughes	0.00%	0.00%	0.00%
Lockheed Martin	16.67%	50.00%	66.67%
LTV	0.00%	0.00%	0.00%
Martin Marietta	40.00%	40.00%	80.00%
McDonnell Douglas	0.00%	0.00%	0.00%
Northrop Grumman	0.00%	33.33%	33.33%
Raytheon	25.00%	25.00%	50.00%
Stewart Stevenson	0.00%	0.00%	0.00%
Texas Instruments	100.00%	0.00%	100.00%
TRW	0.00%	100.00%	0.00%
Averages	19.61%	34.06%	47.00%

Of the weapons systems included in this analysis, Lockheed Martin, Boeing, and Northrop Grumman, the three largest defense contractors respectively, based on 2006-awarded contracts, manufactured approximately 34.8 percent. Of these weapons systems, on average, approximately 76.4 percent examined in this report, produced by the "Top Three," manifested a statistically significant change in their cost estimates following mergers. About 62.5 percent of weapons systems manufactured by Lockheed Martin and included in this analysis showed a statistically significant change in cost estimates. Of these systems, 50 percent exhibited a statistically significant decrease in their cost estimates. About 66.7 percent of the weapons systems manufactured by Boeing manufactured weapons systems and included in this report showed a statistically significant change in cost estimates. Of these systems, 50 percent exhibited a statistically significant decrease in their cost estimates. Finally, all of the systems manufactured by Northrop Grumman and included in this report showed a statistically significant reduction in cost estimates.

Table 6 looks at the impact of three major mergers in the defense arena: the merger between Lockheed and Martin Marietta (effective on March 16, 1995), the merger between Boeing and McDonnell Douglas (effective on August 1, 1997), and the merger between Northrop Corporation and Grumman Aerospace (effective on April 18, 1994) on the weapons systems manufactured by these prime defense contractors[16].

On average, approximately 66.7 percent of the weapon systems manufactured by General Dynamics and Raytheon, the fourth and fifth largest defense contractors based on 2006 awarded contracts, experienced a significant change in cost estimates. In general, in the post-merger periods, DoD's costs often tended to be lower for a great number of weapons systems manufactured by the leading defense contractors.

[16]Two of these three mergers were examined in Nayantara Hensel's report " An Empirical Analysis of the Patterns in Defense Industry Consolidation and their Subsequent Impact" (2007).

Table 6. Impact of Selected Defense Mergers on Weapons Systems Cost Estimates

Largest Defense Contractors (Based on contract awards as of 2006)	**Percentage of systems made by the defense contractors involved in a specific merger which experienced a statistically significantly higher cost estimate post-merger**	**Percentage of systems made by defense contractors involved in a specific merger which experienced a statistically significantly lower cost estimate post-merger**	**Percentage of systems made by the defense contractors involved in a specific merger which experienced a statistically significantly different estimate post-merger (higher or lower)**
Lockheed / Martin Marietta (March 16, 1995) ASAS ATACMS C-130 F-22 Longbow Hellfire Titan IV DMSP Trident	12.50%	50.00%	62.50%
Boeing / McDonnell Douglas (August 1, 1997) AV-8B C-17 FA-18 JDAM Longbow Apache T45TS	16.67%	50.00%	66.67%
Northrop/Grumman (April 18, 1994) JSTAR E-2C	0.00%	100.00%	100.00%
Average	9.72%	66.67%	76.39%

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VI. CONCLUSION

This report's objective was to examine the effect of the defense industry consolidation on the cost of weapons systems by analyzing pre-merger and post-merger costs to DoD.

The analysis of the data suggests that, even though the defense industry has undergone a dramatic consolidation, this landscape has not translated into higher costs for DoD's military weapons in the post-merger period. This report concludes that, on average, approximately 76.3 percent of the weapons systems produced by Lockheed Martin, Boeing, or Northrop Grumman, the three largest defense contractors respectively, based on 2006-awarded contracts, showed a statistically significant change in their cost estimates.

About 62.5 percent of weapons systems manufactured by Lockheed Martin and included in this analysis showed a statistically significant change in cost estimates. Of these systems, 50 percent exhibited a statistically significant decrease in their cost estimates. About 66.7 percent of the weapons systems manufactured by Boeing manufactured weapons systems and included in this report showed a statistically significant change in cost estimates. Of these systems, 50 percent exhibited a statistically significant decrease in their cost estimates. Finally, all of the systems manufactured by Northrop Grumman and included in this report showed a statistically significant reduction in cost estimates.

Weapon systems in the fixed-wing aircraft category were most impacted by defense-related mergers. About 72.2 percent of the systems in this category had a statistically significant changes in cost estimates. Of these systems, 63.6 percent exhibited a statistically significant decrease and approximately 9.1 percent experienced a statistically significant increase in cost estimates post-merger. Weapon systems in the strategic electronics category were also highly impacted by defense-related mergers. About 75 percent of the systems in this category experienced a statistically significant change in cost estimates, of which

50 percent showed a statistically significant decrease, and approximately 25 percent showed a statistically significant increase in cost estimates following the merger.

Additional research on a larger sample of weapons systems spread across multiple sectors is necessary to understand further the effect of defense market consolidation on the cost of military weapon systems. Also, consideration should be given to changes by DoD in the quantities of weapons systems procured. Finally, the impact of funding levels, defense priorities and political landscapes should also be considered when analyzing changes in the SAR data.

APPENDIX

EXPANDABLE LAUNCH VEHICLES

WEAPON SYSTEM: TITAN IV
PRIMARY FUNCTION: SPACECRAFT PROPULSION
SERVICE: US AIR FORCE

FIXED WING AIRCRAFTS

WEAPON SYSTEM: F-16 “FIGHTING FALCON”
PRIMARY FUNCTION: MULTIROLE FIGHTER
SERVICE: US AIR FORCE

WEAPON SYSTEM: F-22 “RAPTOR”
PRIMARY ROLE: AIR SUPERIORITY FIGHTER
SERVICE: US AIR FORCE

WEAPON SYSTEM: FA-18 “SUPER HORNET”
PRIMARY FUNCTION: MULTIROLE FIGHTER
SERVICE: US NAVY

WEAPON SYSTEM: GLOBAL HAWK
PRIMARY FUNCTION:
SERVICE: US AIR FORCE

WEAPON SYSTEM: C-130J “HERCULES”
PRIMARY FUNCTION: CLOSE AIR SUPPORT/AIR INTERDICTION
SERVICE: US AIR FORCE

WEAPON SYSTEM: C-17 “GLOBEMASTER III”
PRIMARY FUNCTION: CARGO AND TROOP TRANSPORT
SERVICE: US AIR FORCE

WEAPON SYSTEM: E-8C "JSTARS"
PRIMARY FUNCTION: AIRBORNE BATTLE MANAGEMENT
SERVICE: US AIR FORCE

WEAPON SYSTEM: "JPATS"
PRIMARY FUNCTION: UNMANNED SURVEILLANCE AIRCRAFT
SERVICE: US AIR FORCE

ROTARY AIRCRAFT

WEAPON SYSTEM: AH-64A/D “LONGBOW APACHE”
PRIMARY FUNCTION: ATTACK HELICOPTER
SERVICE: US ARMY

WEAPON SYSTEM: V-22 “OSPREY”
PRIMARY FUNCTION: ATTACK HELICOPTER
SERVICE: JOINT

SATELLITES

WEAPON SYSTEM: NAVSTAR
PRIMARY FUNCTION: GLOBAL POSITIONING SYSTEM
SERVICE: JOINT

MISSILES

WEAPON SYSTEM: TRIDENT II
PRIMARY FUNCTION: STRATEGIC NUCLEAR DETERRENCE
SERVICE: US NAVY

WEAPON SYSTEM: AIM-9X “SIDEWINDER”
PRIMARY FUNCTION: AIR TO AIR MISSILE
SERVICE: JOINT

WEAPON SYSTEM: “JDAM”
PRIMARY FUNCTION: CLOSE AIR SUPPORT/OFFENSIVE COUNTER AIR
SERVICE: US AIR FORCE/NAVY

SURFACE SHIPS

WEAPON SYSTEM: DDG-51
PRIMARY FUNCTION: MULTI-MISSION GUIDED DESTROYER
SERVICE: US NAVY

WEAPON SYSTEM: LHD-51
PRIMARY FUNCTION: MULTI PURPOSE AMPHIBIOUS ASSAULT
SERVICE: US NAVY

WHEELED VEHICLES

WEAPON SYSTEM: M2A3 “BRADLEY”
PRIMARY FUNCTION: PROTECTED TRANSPORT OF TROOPS
SERVICE: US ARMY

WEAPON SYSTEM: M1A2 “BRADLEY”
PRIMARY FUNCTION: HEAVY ARMOR SUPERIORITY
SERVICE: US ARMY

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